

1 WHAT IS CLAIMED IS:

1. A secondary battery having a negative pole substantially made of a negative pole activating material, a positive pole substantially made of a negative pole activating material disposed while interposing a separator from said negative pole and an electrolyte or an electrolytic solution (electrolytic liquid) held between said negative pole and said positive pole, said secondary battery comprising:
 - 10 a film which covers the surface of said negative pole and through which ions relating to battery reactions are able to pass.
 - 15 2. A secondary battery according to claim 1, wherein said film has a molecular structure or apertures having gaps larger than the ions relating to said battery reactions.
 - 20 3. A secondary battery according to claim 1, wherein said film has a molecular structure or apertures through which the ions relating to said battery reactions are able to pass but through which a negative pole activating material precipitated to said negative pole at the time of charge cannot pass.
 - 25 4. A secondary battery according to claim 1, wherein said film is stable such that said film does not

1 react with said electrolyte or said electrolytic
solution and said film cannot be dissolved by the same.

5. A secondary battery according to claim 1,
5 wherein said film has an electron donative element or a
group.

6. A secondary battery according to claim 5,
wherein said electron donative element of said film has
10 an unpaired electron, a paired electron or electron d.

7. A secondary battery according to claim 5,
wherein said electron donative group of said film has
15 electron π .

8. A secondary battery according to claim 5 or 6,
wherein said electron denative element of said film has
one or more types of elements selected from a group
consisting of oxygen, nitrogen and sulfur.

20 9. A secondary battery according to claim 1,
wherein said film is in the form of a large ring
compound structure.

25 10. A secondary battery according to claim 1,
wherein said film is in the form of an aromatic ring
structure.

1 11. A secondary battery according to claim 1,
wherein said film is fluororesin.

5 12. A secondary battery according to claim 1,
wherein said film is in the form of an ether bond
structure.

10 13. A secondary battery according to claim 1,
wherein said film has a carbonyl group.

14. A secondary battery according to claim 1,
wherein said film is in the form of a structure in which
phosphorus atoms and nitrogen atoms are alternately
double-bonded in a phosphorus-nitrogen manner.

15 15. A secondary battery according to claim 1,
wherein said film is made of a glass-type metal oxide.

16. A secondary battery according to claim 1,
20 wherein said film has a polymer structure.

17. A secondary battery according to claim 1,
wherein said film has a crosslinked polymer structure.

25 18. A secondary battery according to claim 1,
wherein said film includes conductor powder dispersed
therein.

1 19. A secondary battery according to claim 1,
wherein said negative pole activating material is
lithium or lithium alloy.

5 20. A secondary battery according to claim 1,
wherein said negative pole activating material is zinc
or zinc alloy.

10 21. A secondary battery according to claim 19,
wherein said surface of said negative pole covered with
said film is subjected to lipophilic treatment.

15 22. A secondary battery according to claim 20,
wherein said surface of said negative pole covered with
said film is subjected to hydrophilic treatment.

20 23. A secondary battery according to claim 1,
wherein at least the surface of said separator opposing
said negative pole is covered with the same material
which forms said film.

25 24. A secondary battery having a negative pole
substantially made of a negative pole activating
material, a positive pole substantially made of a
negative pole activating material disposed while
interposing a separator from said negative pole and an
electrolyte or an electrolytic solution (electrolytic

1 liquid) held between said negative pole and said
positive pole, said secondary battery comprising:
at least a surface of said negative pole
opposing said positive pole is treated with a reactive
5 and gaseous material containing a nitrogen element or a
halogen element.

25. A secondary battery according to claim 24,
wherein said reactive and gaseous materials a plasma-
10 type material.

26. A secondary battery according to claim 24,
wherein said material containing nitrogen is one or more
types of materials selected from a group consisting of
15 nitrogen, ammonia and nitrogen trifluoride.

27. A secondary battery according to claim 24,
wherein said material containing said halogen element
is one or more types of materials selected from a group
20 consisting of fluorine, chlorine, hydrogen fluoride,
hydrogen chloride, nitrogen trifluoride and a carbon
halide such as carbon tetrafluoride.

28. A secondary battery according to claim 24,
25 wherein one or more types of gases selected from a group
consisting of oxygen gas, hydrogen gas, argon gas,
helium gas and xenon gas are added to said reactive and

1 gaseous raw material gas containing the nitrogen element
or halogen element to treat the surface of said negative
pole.

5 29. A secondary battery according to claim 24,
wherein said reactive and gaseous material is a material
in a plasma state which treats the surface of said
lithium negative pole.

10 30. A secondary battery according to claim 24,
wherein said negative pole activating material is
lithium or lithium alloy.

15 31. A secondary battery having a negative pole
substantially made of a negative pole activating
material, a positive pole substantially made of a
negative pole activating material disposed while inter-
posing a separator from said negative pole and an
electrolyte or an electrolytic solution (electrolytic
20 liquid) held between said negative pole and said
positive pole, said secondary battery comprising:
one or more types of layers selected from a
group consisting of a conductor layer, a semiconductor
layer and an insulating layer and disposed between said
25 negative pole and said separator.

32. A secondary battery according to claim 31,

1 wherein said negative pole is made of lithium, lithium
alloy, zinc or zinc alloy.

33. A secondary battery according to claim 31,
5 wherein said conductor layer or said semiconductor layer
is made of one or more types of elements selected from
a group consisting of carbon, Ni, Ti, Pt and Si.

34. A secondary battery according to claim 31,
10 wherein said insulating layer is one or more types of
insulators selected from a group consisting of halide,
nitride and carbide.

35. A secondary battery according to claim 31,
15 wherein a layer selected from a group consisting of
said conductor layer, said semiconductor layer and said
insulating layer is in contact with said negative pole
activating material.

20 36. A secondary battery according to claim 31,
wherein a layer selected from a group consisting of said
conductor layer, said semiconductor layer and said
insulating layer is in contact with said separator.

25 37. A secondary battery according to claim 31,
wherein a layer selected from a group consisting of said
conductor layer, said semiconductor layer and said

1 insulating layer covers at least the surface of said
negative pole activating material adjacent to said
separator.

5 38. A secondary battery according to claim 31,
wherein a layer selected from a group consisting of said
conductor layer, said semiconductor layer and said
insulating layer is pressed and secured to the surface
of said negative pole activating material.

10

39. A secondary battery according to claim 31,
wherein a layer selected from a group consisting of
said conductor layer, said semiconductor layer and said
insulating layer covers at least the surface of said
15 separator adjacent to said negative pole.

20

40. A secondary battery according to claim 36,
wherein a layer selected from a group consisting of said
conductor layer, said semiconductor layer and said
insulating layer is pressed and secured to said
separator.

25

41. A secondary battery according to claim 31,
wherein said conductor layer is made of carbon fiber
having a specific area of $10 \text{ m}^2/\text{g}$ and a void ratio of
50 % or more.

1 42. A secondary battery having a negative pole
made of a negative pole activating material and a
positive pole made of a positive pole activating
material and arranged in such a manner that said
5 negative pole activating material and said positive pole
activating material are separated from each other by a
separator, said secondary battery comprising:
 at least a multi-layer metal oxide formed
 between said positive pole and said negative pole.

10
15 43. A secondary battery according to claim 42,
wherein said multi-layer metal oxide contains one or
more types of materials selected from a group consisting
of alumina, titanium oxide, silica, selenium oxide,
zirconia oxide, magnesium oxide, chrome oxide, calcium
oxide, tin oxide, indium oxide and germanium oxide.

20 44. A secondary battery according to claim 42,
wherein said multi-layer metal oxide is formed by a mold
made of bimolecular film.

25 45. A secondary battery according to claim 44,
wherein said bimolecular film is a compound (a
amphipathic material) having both hydrophobic group and
a hydrophilic group.

46. A secondary battery according to claim 44,

- 1 wherein said bimolecular film is formed in a film shape combining an amphipathic material and a polymer compound.
- 5 47. A secondary battery according to claim 44, wherein said bimolecular film is a reactant (polyion complex) of an ionic amphipathic material and a polymer electrolyte.
- 10 48. A secondary battery according to claim 42, wherein said multi-layer metal oxide is a composite of an organic polymer.
- 15 49. A secondary battery according to claim 42, wherein said multi-layer metal oxide is a portion of said separator.
- 20 50. A secondary battery according to claim 42, wherein the surface of said positive pole made of said positive pole activating material and opposing said negative pole is covered with at least a film through which ions relating to battery reactions are able to pass.
- 25 51. A secondary battery according to claim 42, wherein the surface of said negative pole made of said negative pole activating material and opposing said

1 positive pole is covered with at least a film through
which ions relating to battery reactions are able to
pass.

5 52. A secondary battery according to claim 42,
wherein said film through which the ions relating to the
battery reactions are able to pass is made of a multi-
layer metal oxide prepared in a mold made of a
bimolecular film.

10

53. A secondary battery according to claim 42,
wherein said negative pole activating material is
lithium or lithium alloy.

15

54. A secondary battery according to claim 42,
wherein said negative pole activating material is zinc
or zinc alloy.

20

55. A secondary battery according to claim 42,
wherein said multi-layer metal oxide is subjected to
lipophilic treatment.

25

56. A secondary battery according to claim 42,
wherein said multi-layer metal oxide has a conductor
member on the surface thereof which opposes said
negative pole.

1 57. A secondary battery comprising:

a negative pole substantially made of a negative
pole activating material;

5 a positive pole substantially made of a ~~negative~~
pole activating material disposed while interposing a
separator from said negative pole; and

an electrolyte or an electrolytic solution
(electrolytic liquid) held between said negative pole
and said positive pole, wherein

10 at least the surface of said positive pole
opposing said negative pole is covered with one or more
layers selected from a group consisting of an insulating
film, a semiconductor film and a composite film of an
insulating material and a semiconductor through which
15 ions relating to battery reactions are able to pass.

58. A secondary battery according to claim 57,
wherein said insulating member through which the ions
are able to pass is a large ring compound through which
20 the ions relating to the battery reactions are able to
pass.

59. A secondary battery according to claim 58,
wherein said large ring compound is a ring compound
25 having one or more types of structures selected from a
group consisting of a ring polyether, a ring polyamine,
ring polythioether, azacrown ether, ring thioether,

1 thiocrown ether, cryptand, cyclam, cyclodextrin,
cyclofan, phthalocyanin and porphyrin compound.

60. A secondary battery according to claim 57,
5 wherein said insulating member through which the ions
are able to pass is a polymer of a derivative of an
aromatic hydrocarbon.

61. A secondary battery according to claim 60,
10 wherein said derivative of the aromatic hydrocarbon is
one or more types of derivatives selected from a group
consisting of naphthalene, anthracene, phenanthlene,
naphthacene, pyrene, triphenylene, perillene, picene,
benzopyrene, coronene and ovalene.

15

62. A secondary battery according to claim 57,
wherein said insulating member through which the ions
are able to pass is fluororesin.

20

63. A secondary battery according to claim 62,
wherein said fluororesin has an ether bond.

25

64. A secondary battery according to claim 57,
wherein said insulating member through which the ions
are able to pass is silicone resin which is an organic
silicon compound.

1 65. A secondary battery according to claim 57,
wherein said insulating member through which the ions
are able to pass is a titanium polymer which is an
organic titanium compound.

5

66. A secondary battery according to claim 57,
wherein said insulating member through which the ions
are able to pass is a polymer in which phosphorus atoms
and nitrogen atoms alternately form phosphorus-nitrogen
10 double bonds.

67. A secondary battery according to claim 57,
wherein said insulating member through which the ions
are able to pass is inorganic glass mainly composed of
15 an inorganic oxide.

68. A secondary battery according to claim 67,
wherein said inorganic glass is combined with an organic
polymer.

20

69. A secondary battery according to claim 67,
wherein said inorganic oxide contains oxides of one or
more elements selected from a group consisting of
silicon, titanium, aluminum, magnesium, zirconium, lead
25 and calcium.

70. A secondary battery according to claim 57,

RECORDED IN U.S. PATENT AND TRADEMARK OFFICE

1 wherein said insulating member through which the ions
are able to pass is a carbide.

71. A secondary battery according to claim 57,
5 wherein said insulating member through which the ions
are able to pass is a nitride.

72. A secondary battery according to claim 57,
wherein said insulating member through which the ions
10 are able to pass is a halide.

73. A secondary battery according to claim 72,
wherein said halide is a fluoride.

15 74. A secondary battery according to claim 57,
wherein said insulating member through which the ions
are able to pass contains one or more types of elements
selected from a group consisting of carbon and silicon.

20 75. A secondary battery according to claim 57,
wherein the surface of said negative pole is covered
with a film through which ions relating to battery
reactions are able to pass.

25 76. A secondary battery according to claim 57,
wherein said negative pole is made of lithium or lithium
alloy and said ions relating to the reactions are

1 lithium ions.

77. A secondary battery according to claim 57,
wherein said negative pole is made of zinc or zinc alloy
5 and said ions relating to the reactions are hydroxide
ions.

78. A secondary battery comprising:
a negative pole substantially made of a negative
10 pole activating material;
a positive pole substantially made of a ~~negative~~
pole activating material disposed while interposing a
separator from said negative pole; and
an electrolyte or an electrolytic solution
15 (electrolytic liquid) held between said negative pole
and said positive pole, wherein
said positive pole activating material is mainly
composed of a compound of one or more types of transition
metal having a crystal grain size of 500 Å or less and a
20 group 6A element.

79. A secondary battery according to claim 78,
wherein said positive pole activating material is an
aggregate selected from a group consisting of amorphous,
25 microcrystal, a mixture of amorphous and microcrystal
and a mixture of amorphous, microcrystal and multi-
crystal.

1 80. A secondary battery according to claim 78,
wherein said positive pole activating material contains
hydrogen.

5 81. A secondary battery according to claim 80,
wherein said positive pole activating material has a
hydroxide.

10 82. A secondary battery according to claim 78,
wherein said positive pole activating material contains
one or more types of elements selected from a group
consisting of lithium, carbon, magnesium, sodium,
potassium, nitrogen, aluminum, calcium, barium, lead,
indium, boron, silicon, tin, phosphorus, arsenic,
15 antimony, bismuth, fluorine and chlorine.

20 83. A secondary battery according to claim 78,
wherein said group 6A element which is the main compo-
nent of said positive pole activating material is oxygen.

25 84. A secondary battery according to claim 78,
wherein said group 6A element which is the main component
of said positive pole activating material is sulfur.

25 85. A secondary battery according to claim 78,
wherein said positive pole activating material is
applied with coating treatment with a conductor.

1 86. A secondary battery according to claim 78,
wherein a positive pole activating material of a type in
which conductor powder serving as the core is covered
with a compound of said transition metal and said group
5 6A element is used.

87. A secondary battery according to claim 78,
wherein said positive pole activating material contains
one or more materials selected from a group consisting
10 of carbon material, a resin material and a metal
material mixed thereto to form a positive pole.

88. A secondary battery according to claim 78,
wherein said positive pole activating material is
15 subjected to lipophilic treatment.

89. A secondary battery according to claim 88,
wherein said lipophilic treatment is treatment using an
organic metal compound.

20
90. A secondary battery according to claim 87,
wherein said resin material contains one or more types
of resins selected from a group consisting of
fluororesin, polyethylene, polypropylene and silicon
25 resin.

91. A secondary battery according to claim 90,

1 wherein said resin material is a resin in the form of
liquid or molten liquid or a resin having a low melting
point.

5 92. A secondary battery according to claim 91,
wherein said resin is fluororesin having an ether bond.

93. A secondary battery according to claim 78,
wherein said negative pole activating material is
10 composed of one or more types of materials selected from
a group consisting of lithium, lithium alloy and carbon.

94. A secondary battery according to claim 78,
wherein the surface of said negative pole activating
15 material of said secondary battery is covered with a
film through which lithium ions are able to pass.

95. A secondary battery according to claim 78,
wherein said electrolyte is composed of at least an
20 alkali metal compound.

96. A secondary battery according to claim 78,
wherein said electrolyte is in a state selected from a
group consisting of a solid state, a molten liquid state
25 dissolved in a non-water-soluble solvent and a solid-
liquid state.

1 97. A method of manufacturing a positive pole
activating material of a secondary battery, said method
comprising the steps of:

5 forming a compound having a crystal grain size
of 500 \AA or less and composed of transition metal and a
group 6A element by using a reaction selected from a
group consisting of a solution reaction, a gas phase
reaction and a melting and rapid cooling reaction.

10 98. A method of manufacturing a positive pole
activating material according to claim 97, wherein said
compound of said transition metal and said group 6A
element is an aggregate selected from a group consisting
of amorphous, microcrystal, a mixture of amorphous and
15 microcrystal and a mixture of amorphous, microcrystal
and multi-crystal.

20 99. A method of manufacturing a positive pole
activating material according to claim 97, wherein said
positive pole activating material is substantially
composed of a compound of said transition metal and said
group 6A element, the raw material of said transition
metal element of said compound of said transition metal
and said group 6A element being one or more types of
25 materials selected from a group consisting of said
transition metal, salt of said transition metal, an
organic metal compound of said transition metal, hydride

1 of said transition metal, hydrogated material of said transition metal, carbonyl compound of said transition metal and a transition metal oxide.

5 100. A method of manufacturing a positive pole activating material according to claim 97, wherein said positive pole activating material is composed of a compound of said transition metal and said group 6A element, the raw material of said group 6A element of
10 said compound of said transition metal and said group 6A element being one or more types of materials selected from a group consisting of water, alcohol, hydride, hydrogated material and halide.

15 101. A method of manufacturing a positive pole activating material according to claim 97, wherein said group 6A element is oxygen.

20 102. A method of manufacturing a positive pole activating material according to claim 97, wherein said group 6A element is sulfur.

25 103. A method of manufacturing a positive pole activating material according to claim 97, wherein said process for forming said compound of said transition metal and said group 6A element includes a process for causing hydrogen to react.

1 104. A method of manufacturing a positive pole
activating material according to claim 97, wherein said
positive pole activating material is composed of a
compound of said transition metal and said group 6A
5 element and said solution reaction includes at least a
process for forming a hydroxide of said transition metal
by using one or more reactions selected from a group
consisting of a reaction between a salt of said
transition metal and alkali, a hydrolysis reaction of an
10 organic transition metal compound and a reaction between
said transition metal and alkali.

15 105. A method of manufacturing a positive pole
activating material according to claim 97, wherein said
gas phase reaction includes at least a process for
causing gasified transition metal salt or an organic
transition metal compound or vapor of said transition
metal and said group 6A element or a compound of said
group 6A element to react with each other in a gas phase
20 or a process for decomposing transition metal salt
containing gasified group 6A element or an organic
transition metal compound in a gas phase so that said
compound of said transition metal and said group 6A
element is prepared.

25

106. A method of manufacturing a positive pole
activating material according to claim 97, wherein said

1 activating material is composed of a compound of said
transition metal and said group 6A element and said
melting and rapid cooling reaction includes at least a
process for melting one or more types of materials
5 selected from a group consisting of said transition
metal and said transition metal compound to be caused to
react with one or more types of materials selected from
a group 6A element and said group 6A element compound
and rapidly cooling said reactant.

10

107. A method of manufacturing a positive pole
activating material according to claim 97, wherein said
positive pole activating material is composed of said
transition metal and said group 6A element and at least
15 of a process for applying supersonic vibrations is
provided.

108. A method of manufacturing a positive pole
activating material according to claim 99, wherein said
salt of said transition metal is one or more types of
20 salts selected from a group consisting of nitrate,
carbonate, sulfate, halide, phosphate, borate, salt of
organic acid and ammonia salt.

25 109. A method of manufacturing a positive pole
activating material according to claim 99, wherein said
organic transition metal compound is one or more types

1 of salts selected from a group consisting of metal
alkoxide, acetylacetone, salt of octylic acid and
naphthenate.

5 110. A method of manufacturing a positive pole
activating material according to claim 104, wherein acid
and/or alkali is added in said hydrolysis reaction of
said organic transition metal compound.

10 111. A method of manufacturing a positive pole
activating material according to claim 104 further
comprising a dehydrating reaction process.

15 112. A method of manufacturing a positive pole
activating material according to claim 104 further
comprising a process for causing hydrogen sulfide to
react.

20 113. A method of manufacturing a positive pole
activating material according to claim 105, wherein a
solid transition metal salt or a organic transition
metal compound is heated to be formed into vapor or
heated to be liquid and a carrier gas is bubbled as to
be introduced into a reaction chamber or a solution
25 dissolved in a solvent is introduced into said reaction
chamber while bubbling said carrier gas so that a gas
phase reaction is caused to take place.

1 114. A method of manufacturing a positive pole
activating material according to claim 105, wherein said
liquid transition metal salt or said organic transition
metal compound is heated to be formed into vapor or
5 carrier gas is bubbled to be introduced into a reaction
chamber so that a gas phase reaction is caused to take
place.

10 115. A method of manufacturing a positive pole
activating material according to claim 106, wherein a
rapid cooling rate is 10^1 to 10^8 K per second.

15 116. A method of manufacturing a positive pole
activating material according to claim 97 and made of a
compound of said transition metal and said group 6A
element further comprising at least a step of adding one
or more types of elements selected from a group
consisting of lithium, carbon, magnesium, sodium,
potassium, nitrogen, aluminum, calcium, barium, lead,
20 indium, boron, silicon, tin, phosphorus, antimony,
bismuth, fluorine and chlorine.

25 117. A method of manufacturing a positive pole
activating material according to claim 116, wherein the
raw material of the additive elements to be added to
said positive pole activating material is one or more
types of materials selected from a group consisting of

1 said additive element, salt of said additive element, organic compound of said additive element, hydride of said additive element and hydrgated material of said additive element.

5

118. A method of manufacturing a positive pole activating material according to claim 97 further comprising a step of mixing conductor powder to be used as the core of said compound of said transition metal 10 and said group 6A element.

119. A method of manufacturing a positive pole activating material according to claim 97 further comprising a step of covering by using a conductor after 15 said compound of said transition metal and said group 6A element has been prepared.

120. A method of manufacturing a positive pole comprising the step of:

20 mixing one or more types or resins selected from a group consisting of fluorine resin, polyethylene, polypropylene and silicon resin into said positive pole activating material prepared by said manufacturing method according to claim 97.

25

121. A method of manufacturing a positive pole according to claim 120, wherein said resin material is

1 liquid or solution or low melting point resin.

122. A method of manufacturing a positive pole
according to claim 120, wherein said resin material is
5 fluorine resin having an ether bond.

10

15

20

25